

CLAIMS

1. A drive unit, comprising:
a driven element; and
a plurality of actuators for driving the driven element,
each of the plurality of actuators comprising an
electro-mechanical converting element which applies driving
force to the driven element when electric power is applied
thereto, wherein the driven element is driven by cooperatively
driving the plurality of actuators.
2. The drive unit as claimed in claim 1, wherein the
electro-mechanical converting element is a vibrating element
containing a piezoelectric material.
3. The drive unit as claimed in claim 2, wherein the vibrating
element in at least one of the plurality of actuators is provided
in abutment with the driven element so that the vibrating
element applies force to the driven element by means of
vibration thereof to drive the driven element directly.
4. The drive unit as claimed in claim 1, wherein at least
one of the plurality of actuators drives the driven element
indirectly.
5. The drive unit as claimed in claim 2, further comprising
at least one moving element which works with the driven element
and is in abutment with the vibrating element of the actuator
wherein the vibrating element applies force to the moving
element by means of vibration thereof so as to drive the moving
element and thereby drive the driven element indirectly.
6. The drive unit as claimed in claim 5, wherein the moving
element is a rotor provided rotatably.
7. The drive unit as claimed in claim 5, further comprising

at least one decelerator provided in a power transmission path between the at least one moving element and the driven element.

8. The drive unit as claimed in claim 1, wherein each actuator is an electromagnetic motor mechanism and the electro-mechanical converting element is an excited coil.

9. The drive unit as claimed in claim 1, wherein the driven element is a rotor provided rotatably.

10. The drive unit as claimed in claim 1, wherein the cooperative driving motion of the actuators includes at least one of a first mode in which at least two of the plurality of actuators are synchronized to drive the driven element, a second mode in which the driven element is driven with a phase difference between at least two of the plurality of actuators, and a third mode in which at least two of the plurality of actuators are driven in a differential manner to drive the driven element.

11. The drive unit as claimed in claim 10, wherein the differential manner includes at least one of three modes which includes a first mode in which at least two of the plurality of actuators respectively have drive speeds that are different from each other to drive the driven element in one direction, a second mode in which at least one of the plurality of actuators is driven in the direction reverse to the drive direction of the driven element, and a third mode in which at least one of the plurality of actuators is in a non-driving state.

12. The drive unit as claimed in claim 10, wherein the drive unit is constructed so that, when the driven element is to be stopped, at least two of the plurality of actuators are driven in the differential manner thereby stopping the actuators.

13. The drive unit as claimed in claim 10, wherein the

plurality of actuators includes a main actuator having a high output characteristic and a sub actuator having a low output characteristic, and the drive unit is constructed so that, in the third mode, the main and sub actuators are driven in the differential manner to drive the driven element.

14. The drive unit as claimed in claim 1, wherein at least one of the plurality of actuators has an output characteristic different from that of each of the other actuators.

15. A drive unit, comprising:
at least two driven elements; and
a plurality of actuators for driving the driven elements, respectively, each of the plurality of actuators comprising an electro-mechanical converting element which applies driving force to the driven element when electric power is applied thereto, wherein the driven elements are driven by cooperatively driving the plurality of actuators.

16. The drive unit as claimed in claim 15, wherein each of the plurality of actuators drives one of the driven elements.

17. An operating apparatus, comprising:
a drive unit which comprises:
a driven element; and
a plurality of actuators for driving the driven element, each of the plurality of actuators comprising an electro-mechanical converting element which applies driving force to the driven element when electric power is applied thereto, wherein the driven element is driven by cooperatively driving the plurality of actuators; and
a controlled element driven by the drive unit in a controlled manner.

18. The operating apparatus as claimed in claim 18, wherein the controlled element includes a robot arm body.

19. An operating apparatus, comprising:
a drive unit which comprises:
at least two driven elements; and
a plurality of actuators for driving the driven elements, respectively, each of the plurality of actuators comprising an electro-mechanical converting element which applies driving force to the driven element when electric power is applied thereto, wherein the driven elements are driven by cooperatively driving the plurality of actuators; and
a controlled element driven by the drive unit in a controlled manner.
20. The operating apparatus as claimed in claim 19, wherein the controlled element includes a robot arm body.